CLAIMS

What is claimed is :

1. Method for increasing the range of production of an installation for cold rolling of strip-shaped material, at least consisting of two rolling stands (L1, L2) operating in tandem for gradually reducing the thickness of product (M), each stand being associated with means (15, 16) of applying a rolling force between two work rolls (2, 2'), allowing, for a given stand configuration, a certain percentage of thickness reduction to be achieved, taking into account the dimensional, mechanical and metallurgical properties of the product, whereby said properties are related to a given production range, a Method in which at least one (L1) of the stands is equipped with means of converting the configuration of the stand, hence convertible, while keeping the same means (15, 16, 3, 3') of applying the rolling force, in order to have at least two configurations each suited for one production range, and for rolling a product M, the configuration of the convertible stand is selected according to the rolled product (M) data so that said product data are within the production range corresponding to the selected configuration.

2. Method as claimed in claim 1, characterized in that the convertible stand configuration is selected according to the rolled material hardness.

3. Method as claimed in claim 2, characterized in that the production range of the installation includes products with a breaking point after hot Methoding ranging from less than 160 MPa to at least 1000 MPa.

4. Method as claimed in one of the preceding claims for increasing the production range of a rolling installation, at least consisting of two rolling stands (L1, L2), each associated with means of controlling at least one of the quality factors such as thickness regularity, flatness and/or surface roughness, characterized in that the configuration of at least one of the rolling stands (L1) is changed depending on the dimensional, mechanical and metallurgical properties of product (M) to maintain the same quality throughout the global production range of the installation.

5. Method as claimed in one of the preceding claims, characterized in that, to match the specific data of a product (M) to be rolled, the configuration of at least one convertible stand (L1) is changed from a four-high arrangement comprising two work rolls (2, 2') supported on two back-up rolls

(3, 3') to a six-high arrangement comprising two work rolls (22, 22') supported, via two intermediate rolls (32, 32') on the same back-up rolls (3, 3'), and reversely.

6. Method as claimed in one of claims 1 to 4, characterized in that, to match the specific data of the product (M) to be rolled, the configuration of at least one convertible stand (L1) is changed from a six-high arrangement comprising two work rolls (22, 22') supported respectively, via one pair of first intermediate rolls (32, 32'), on one pair of back-up rolls (3, 3') to an "eight-high" arrangement comprising two work rolls (61, 61') supported respectively, via a pair of second intermediate rolls (62, 62'), on the same first intermediate rolls (32, 32') and the same back-up rolls (3, 3'), and reversely.

7. Method as claimed in one of the claims 5 and 6, characterized in that at least one convertible stand (L1) is equipped with removable work roll lateral back-up means (8, 8') so that, in an additional configuration, very small diameter work rolls (61, 61') that may be associated with lateral back-up means (8, 8') can be used.

8. Method as claimed in one of the preceding claims, characterized in that the configuration of at least the first stand (L1) of the tandem rolling mill is changed in the strip travel direction.

9. Method as claimed in claim 8, characterized in that the first stand (L1) of the tandem mill can be converted to a four-high configuration for rolling strip with a breaking point equal to or lower than 600 MPa.

10. Method as claimed in one of the preceding claims, characterized in that at least the first stand (L1) of the tandem mill can be converted to a six-high configuration for rolling strip with a breaking point equal to or higher than 600 MPa at entry of the mill.

11. Method as claimed in one of the preceding claims, characterized in that the configuration of the first (L1) and of the last (L4) stand of the rolling mill is changed.

12. Method as claimed in one of the preceding claims, characterized in that the configuration of at least one intermediate stand (L2, L3) of the tandem mill is changed.

13. Method as claimed in one of claims 1 to 7, characterized in that the configuration of at least one intermediate stand (L2, L3) of the tandem mill is

changed while keeping the configuration of the first (L1) and of the last (L4) stand of the rolling mill.

14. Method as claimed in one of the preceding claims, characterized in that the configuration of at least one of the stands (L1) of the rolling mill is selected depending on the mechanical and metallurgical properties of the product to allow a minimum thickness reduction of 70% in one pass throughout the global production range.

15. Cold rolling installation for implementing the method according to one of the preceding claims, comprising means of allowing the product (M) to run through a rolling plane (P), successively in at least two rolling stands (L1, L2) operating in tandem, each stand consisting of two housings (10) between which at least four stacked rolls, two back-up rolls (3, 3') and two work rolls (2, 2') respectively, are slidably mounted, in a direction parallel to a roll load plane, and means (15, 16) of applying a rolling force between said rolls with adjustment of respective gaps, characterized in that at least one convertible stand (4) is equipped with means of quickly replacing one first pair of work rolls (2, 2') by two cassette type assemblies (6, 6'), each consisting of a smaller diameter work roll (61, 61'), associated with an intermediate roll (62, 62'), the said convertible stand being thus provided with two possible configurations, a first configuration with at least four rolls fit for a first production range, and a second configuration with at least six rolls fit for a second production range, respectively, while maintaining, for both configurations, at least the same back-up rolls (3, 3') and the same means of applying the rolling force (15, 16).

16. Installation as claimed in claim 15, characterized in that the means of changing the configuration of at least one convertible stand (L1) allow said stand to be converted from a four-high configuration with two work rolls (2, 2') and two back-up rolls (3, 3') to a six-high configuration with two work rolls (22, 22'), two intermediate rolls 32, 32') and the same back-up rolls (3, 3') and reversely.

17. Installation as claimed in claim 15, characterized in that the means of changing the configuration of at least one convertible stand (L1) allow said stand to be converted from a six-high configuration comprising two work rolls (22, 22') supported respectively, via one pair of first intermediate rolls (32, 32'), on one pair of back-up rolls (3, 3'), to an "eight-high" configuration

comprising two work rolls (61, 61') supported respectively, via a pair of second intermediate rolls (62, 62'), on the same first intermediate rolls (32, 32') and the same back-up rolls (3, 3'), and reversely.

18. Installation as claimed in one of the claims 15 to 17, characterized in that at least one convertible stand (L1) is equipped with removable work roll side back-up means (8, 8') so that, in an additional configuration, very small diameter work rolls (61, 61'), associated with the said side back-up means (8, 8'), can be used.

19. Installation as claimed in one of the claims 15 to 18, in which the work rolls and the intermediate rolls are each rotatably mounted on two chocks, each provided with at least two back-up lugs for means of adjusting the conditions under which the rolling force is transmitted, characterized in that said back-up lugs (21, 21') (24, 25) (24', 25') for the work rolls (2, 2') (22, 22') in a first configuration and for intermediate rolls (32, 32') (62, 62') in a second configuration respectively, are arranged substantially at the same level and that the adjusting means (40, 40', 5, 5') (42, 42') are kept in position in the housing (10) of stand (1) during a change of configuration to co-operate with the work rolls (2, 2') (22, 22') in the first configuration and the intermediate rolls (32, 32') (62, 62') in the second configuration.

20. Installation as claimed in Claim 19 in which at least the convertible stand (L1) is equipped with roll bending means (5, 5') mounted on support parts (40, 40') (42, 42') integral with the housings (10) of stand (1), characterized in that, on each side of the rolling plane, the roll bending means (5, 5') are the same in both configurations and co-operate with back-up lugs (21, 24, 25) of the chocks of work rolls (2, 22) in a first configuration and back-up lugs (33, 63) of the chocks of intermediate rolls (32, 62) in a second configuration, respectively, said back-up lugs (21, 24, 25) (34, 64) of the chocks (20, 33, 63) being arranged substantially at the same level relative to rolling plane (P), on each side thereof.

21. Installation as claimed in claim 20, characterized in that the back-up lugs (21, 21') of chocks (20, 20') of work rolls (2, 2') in the first configuration are offset with respect to roll axis, on the side opposite the rolling plane P, and that the back-up lugs (34, 34') of chocks (33, 33') of intermediate rolls (32, 32') in a second configuration are offset toward the rolling plane (P) with respect to roll axis, so that said lugs (21, 21') of work

rolls (2, 2') and (34, 34') of intermediate rolls (32, 32') are arranged substantially at the same level and co-operate with the same bending means (5, 5').

22. Installation as claimed in claim 21, characterized in that the chocks (20, 20') (23, 23') of the work rolls (2, 2') (22, 22') of the first and of the second configuration respectively, are slidably mounted between the guiding faces (12a, 12b) provided at the ends of protruding parts (13a, 13b) integral with the stand housings (10) and supporting bending means (50, 50') that co-operate only with the work rolls (22, 22') of the second configuration.

23. Installation as claimed in claim 20, in which the roll chocks are slidably mounted between guiding faces provided at the ends of support parts (42, 42') supporting the bending means (5, 5'), characterized in that each chock (23, 23') (7, 7') is fitted with two pairs of back-up lugs spaced apart (24, 25, 24', 25') (71, 72, 71', 72') situated above and beneath the support parts (42, 42'), respectively.

24. Installation as claimed in claim 23, characterized in that the chocks (20, 20') of the work rolls (2, 2') of the first configuration and the chocks (33, 33') of the intermediate rolls (32, 32') of the second configuration co-operate with the same bending means (5, 5') supported on support parts (40, 40') integral with the housings (10) of the stand and that the chocks (33, 33') of the intermediate rolls (32, 32') are slidably mounted, in a direction parallel to the roll load plane P1, between guiding faces (41) provided at the ends of said support parts (40, 40').

25. Installation as claimed in claim 24, characterized in that the support parts (40, 40') carrying the bending means (5, 5') of the work rolls (2, 2') in the first configuration and of the intermediate rolls (22, 22') of the second configuration, are slidably mounted, in a direction parallel to roll axes and in opposite directions, above and beneath the rolling plane (P) respectively, in order to adjust the roll gap to the product width in each configuration.

26. Installation as claimed in one of Claims 15 to 25, characterized in that at least one convertible stand (L1) is equipped, in a four-high configuration, with two back-up rolls (3, 3') and two work rolls (2, 2') of fairly large diameter and, in a six-high configuration, with the same back-up rolls

(3, 3'), two work rolls (22, 22') of smaller diameter and two intermediate rolls (32, 32').

27. Installation as claimed in one of Claims 15 to 25, characterized in that at least one convertible stand (L2) is equipped, in a six-high configuration, with one pair of back-up rolls (3, 3'), one pair of first intermediate rolls (32, 32') and one pair of work rolls (22, 22') and, in an eight-high configuration, the same back-up rolls (3, 3') and the same first intermediate rolls (32, 32'), between which two cassette-type assemblies (6, 6') are intercalated, each consisting of one small diameter work roll (61, 61') associated with one second intermediate roll (62, 62').

28. Installation as claimed in claim 27, characterized in that the convertible stand (L1) is equipped with lateral back-up means (8, 8') mounted on housings (10) of stand (1) and shiftable between two positions, a distant position for the six-high configuration and an engaged position for lateral back-up of each small diameter work roll (61, 61'), in the eight-high configuration.

29. Installation as claimed in one of Claims 27, 28, characterized in that each cassette-type assembly (6, 6') of the eight-high configuration comprises one second intermediate roll (62, 62') having two necks, each supported by a holding frame (7, 7') in the form of a chock supporting a bearing (74) and a small diameter work roll (61, 61') having two centering necks, each supported by an axial thrust (75) accommodated in a box (76) connected to the frame (7, 7') holding the second intermediate roll (62, 62') through spring-type means (77) of pressing the work roll (61, 61') on the said second intermediate roll (62, 62').